

A review of the amphidromous species of the *Glossogobius celebius* complex, with description of three new species

by

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ABSTRACT. - Amphidromous species of the *Glossogobius celebius* complex found in lower reaches rivers of the eastern Indian Ocean and the western Pacific Ocean are reviewed. *Glossogobius celebius* is not as widely distributed as previously thought and is confined to the eastern Indian Ocean to eastern Indonesia. Three species are described as new species from Australia, New Guinea and various localities in the western Pacific. The species are distinguished on the basis of coloration, anal fin-ray and predorsal scale counts, head pores and papilla patterns.

RÉSUMÉ. - Revue des espèces amphidromes du complexe *Glossogobius celebius*, avec la description de trois espèces nouvelles.

Les espèces du complexe *Glossogobius celebius* que l'on rencontre dans les rivières du cours inférieur de l'océan Indien oriental et dans l'ouest de l'océan Pacifique sont révisées. *Glossogobius celebius* n'est pas aussi largement distribué que ce qui était communément admis et est limité à l'est de l'océan Indien, à l'est de l'Indonésie. Trois espèces sont décrites comme nouvelles de l'Australie, de la Nouvelle-Guinée et de plusieurs localités du Pacifique occidental. Les espèces se distinguent sur la base de la coloration, du nombre de rayons à la nageoire anale, du nombre d'écailles prédorsales, et des pores et des papilles céphaliques.

Key words. - Freshwater - Gobiidae - *Glossogobius* - Indo-Pacific - New species.

Currently approximately 50 species of the Indo-Pacific gobiid genus *Glossogobius* are known from the Indian Ocean and Western tropical Pacific. Most are restricted to freshwater as adults. Only a few species appear to be widely distributed. Based on ongoing research by the senior author there is evidence of radiations of *Glossogobius* in Papua New Guinea, Sulawesi, Madagascar and the Philippines, with endemics often confined to altitudes above 500 m or lakes. Even at low altitudes a number of undescribed species are known, most reaching a maximum size of less than 60 mm SL. At present 25 described species of *Glossogobius* are recognised (Hoesé and Allen, 2009). Broadly, *Glossogobius* species can be divided into five main groups. One group is characterised by several vertical rows of papillae on the cheek. The group includes a single widespread mangrove dwelling species *Glossogobius circumspectus* (Macleay, 1883) and several landlocked species confined to lakes in Sulawesi. The second group is characterised by a poorly developed mental fraenum, which is normally covered by papillae. The species are generally large sized, with adults reaching a size of greater than 80 mm SL. These species are generally found in lower to mid-reaches of rivers and some species may occur in estuaries and are often geographically widely distributed. The group includes the larger sized species (> 150 mm SL)

Glossogobius aureus Akihito & Meguro, 1975, *G. giuris* (Hamilton, 1822), *G. sparsipapillus* Akihito and Meguro, 1976, one additional species from India, often mistaken for *G. giuris* and at least 3 smaller sized species from the western Indian Ocean. The third group includes species with a compressed head and high number of precaudal vertebrae. This group includes *G. concavifrons* (Ramsay and Ogilby, 1886). The fourth group includes a single species, *Glossogobius bicirrhosus* (Weber, 1894), which has barbells extending from the mental fraenum. The fifth group (*Glossogobius celebius* complex) is characterised by a well-developed, often bilobed mental fraenum. All species are confined to freshwaters as adults, ranging from coastal rivers to altitudes of over 1500 m. It is a large group with over 20 species in Australia, New Guinea and the Philippines (many still undescribed). This paper deals with species in the *Glossogobius celebius* complex that are found just above tidal influence in freshwaters of the western Pacific and eastern Indian Ocean. The species are widely distributed and normally are not found above 100 m in elevation. *Glossogobius celebius* (Valenciennes, in Cuvier & Valenciennes, 1837) was thought to be widespread, ranging from Japan to Australia and eastward to New Caledonia (Akihito and Meguro, 1975). However, evidence is presented here that four closely related spe-

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cies are involved, one wide ranging, known from Japan to eastern Australia, a second restricted to northern Australia and southern New Guinea, the third, *G. celebius*, restricted to Sri Lanka to northern New Guinea and a fourth, rare species sympatric with the west Pacific species. Further studies may well show that other supposedly widespread species are composites of closely related species.

Little is known of the biology of the species of this genus. Many of the species found in the lower parts of rivers, such as *Glossogobius aureus*, *G. bicirrhosus* and *G. giuris* are widely distributed and it is generally assumed that they are amphidromous: they breed in freshwater, have marine larval and post-larval stages and then return to rivers.

MATERIAL AND METHODS

Institution abbreviations follow Leviton *et al.* (1985), except CMK (personal collection of Maurice Kottelat, Cornol, Switzerland) and ZRC (Zoological Research Collection, National University of Singapore). Terminology for papillae follows Hoese (1983) and Akihito and Meguro (1975). Head pore terminology and counts and measurements follow methods outlined in Hoese and Allen (1990). The longitudinal scale count is the number of transverse rows of scales on the body, taken from the upper pectoral insertion of the end of the caudal peduncle. The transverse scale count is taken of the first row behind the anal spine upward and backward to the second dorsal origin. The small scale below the base of the second dorsal fin is counted as a half scale. Counts of the holotypes are indicated by an asterisk.

In material examined lists, the number of specimens is given following the registration number, followed by the size range in mm Standard Length (SL) in parentheses. For non-type material for the new species only the registration number is given for each lot. For Australian material, where multiple lots are known from same locality, only a single lot is listed. Additional material for those species is found in AMS, NTM, QM and WAM collections.

Member of the lowland species of the *Glossogobius celebius* complex share the following features: tongue tip bilobed; mental fraenum distinct with short lateral lobes, free at distal tip; cheek slightly bulbous, without scales; interorbital narrow, much less than eye diameter; interorbital head pores not paired; predorsal area scaled forward to just behind eye, with a narrow naked patch immediately behind eye; operculum with a small patch of scales dorsally; pectoral base largely to fully covered with small cycloid scales; prepelvic area covered with cycloid scales, except for small triangular area anteriorly; belly fully scaled with no naked areas anteriorly, gill rakers on inner face of first arch and other arches denticulate; anal rays typically I,8, longitudinal

scale count 27-33, transverse scale count usually 8.5-9.5 and vertebrae usually 10+17.

Glossogobius celebius

(Figs 1, 2, 13; Tab. I)

Gobius celebius Valenciennes in Cuvier and Valenciennes, 1837: 74 (Celebes).

Material examined

Syntypes of *Gobius celebius*. - MNHN 1385, 1(95) and MNHN 2731, 1(128), Sulawesi.

Other Material. - **Andaman Islands:** CAS-SU 37156, 1(79), Port Blair. Sri Lanka: USNM 268206, 2(55-90), Tributary of Giri Ganga, Hiniduma District. **Halmahera, Indonesia:** USNM 265892, 3(95-100), Kao Bay. **Sulawesi, Indonesia:** CMK 6163, 20(17-52), Sungai Jalange at Desa Mallawa; CMK 6459, 2(52-81); between Malili to Wotu; ZFMK (uncatalogued), 6(33-54), Salo Masareo; ZFMK (uncatalogued), 5(68-89), Halbiusel Peleng; ZFMK (uncatalogued), 1(81), Obi; ZFMK (uncatalogued), 2(65-95), Salo Tolala. **Sumbawa, Indonesia:** NTM S. (uncatalogued) AQ 24, 1(86); NTM S.14055-001, 1(33), Tongoloka River, 09°03.4'S, 116°55.28'E; NTM S.14056-005, 3(32-37), 20 August 1994, rock, mud algae, estuary Tongoloka River, 09°03.4'S, 116°55.56'E; NTM S.14058-006, 1(62), Tartar River, 09°01.54'S, 116°58.39'E; NTM S.14058-011, 1(118), Mid Tartar River, 09°01.54'S, 116°58.39'E; NTM S.14081-010, 2(112-127), Sejong River, 08°59.41'S, 116°48.43'E; NTM S.14150-003, 1(61) Tartar River, 8°59.95'S, 116°59.27'E; NTM S.14513-001, 1(42) Tongoloka River; NTM S.14520-003, 1(105), Tatar River, 09°00.96'S, 116°59.27'E. **Papua:** USNM [ex. 245214], 1(42), between Tandjoeng Manganeki and Tandjoeng Boropen, 00°41.5'S, 133°19.5'E; WAM P.31468-001, 1(57), Batanta Island, 00°54'S, 130°39'E; WAM P.31551-007, 3(43-45), Misool Island, 1°59'S, 129°55'E.

Diagnosis

Mouth moderate; reaching to a point below anterior margin to middle of eye; operculum with a small patch of 10-20 scales dorsally in 2-3 longitudinal rows; second dorsal rays I,8; pectoral rays 18-21 (usually 19 or 20); predorsal scale count 15-19; one or usually two small lateral canal head pores above anterior operculum just before terminal lateral canal pore; papilla line 6 well developed; papilla lines composed of a single row of papillae; snout length 11.6-13.6% SL; body with 5 oval, horizontally elongate brown to black spots on midside from second dorsal origin to posterior end of caudal peduncle; spots usually bordered by faint brown lines above and below.

Description

Based on 61 specimens, 17-128 mm SL. First dorsal spines 6(50*); second dorsal rays I,8(47*), I, 9(3); anal rays



Figure 1. - *Glossogobius celebius*, NTM S.14520-003, 105 mm SL from Sumbawa, Indonesia.

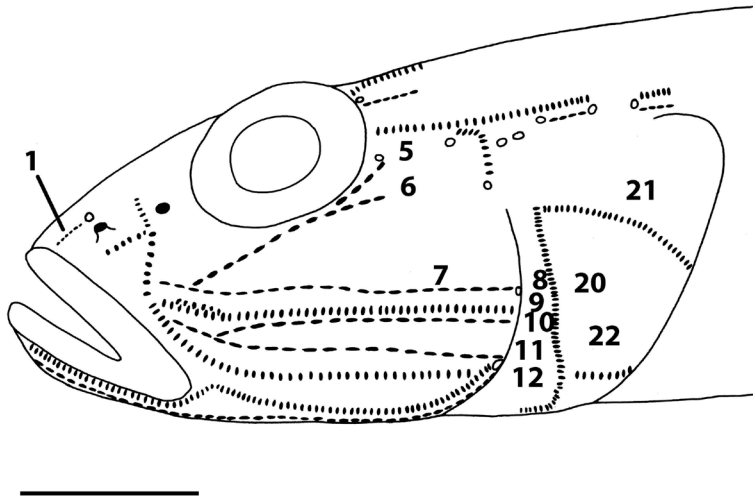


Figure 2. - *Glossogobius celebius*, composite drawing of sensory papillae, based on syntypes and Sumbawa specimens. Scale = 5 mm.

Table I. - Pectoral ray counts in *Glossogobius munroi* n. sp. from various populations in Australia and New Guinea and counts of related species.

Species/Population	17	18	19	20	21	22	23
<i>Glossogobius munroi</i> n. sp.							
Australia	9	41	39	63*	8	–	–
New Guinea	–	–	2	7	12	21	1
<i>Glossogobius celebius</i>	–	–1	10	15	2	–	–
<i>Glossogobius illimis</i> n. sp.	–	4	28*	83	6	–	–
<i>Glossogobius clitellus</i> n. sp.		2	15*	1			

I,7(1), I,8(48*), I,9(1), longitudinal scale count 27(1), 28(5), 29(7*), 30(6), 31(1); predorsal scale count 14(1*), 15(5), 16(2), 17(2), 18(2), 19(4), 20(4), 21(2); transverse scale count (TRB) 8.5(5), 9.5(21*); gill rakers on outer face of first arch 1+1+8 (6), 1+1+9 (1), 1+1+10 (1); lower gill rakers on outer face of second arch 8(5), 9(2); segmented caudal rays 16(1), 17(20); branched caudal rays 12(25*), 13(1*), not showing increase with increasing size; vertebrae 10+16(1*), 10+17(10*). Pectoral ray counts are shown in Table 1.

Head slightly depressed, 27.7-32.5% SL. Snout rounded in dorsal view; convex in side view. Eye moderate about two-thirds length of snout, 6.6-7.7% SL. Small bump below anterior nostril distinct. Anterior nostril at end of short tube,

2-3 nostril diameters above upper lip. Posterior nostril with raised rim, approximately midway between eye and anterior nostril (closer to eye in juveniles and closer to anterior nostril in adult). Preoperculum short, without a spine; distance from end of eye to upper posterior preopercular margin one-half to three-quarters of snout length. Postorbital moderate, length subequal to distance from tip of snout to a point between middle of eye and posterior margin of pupil. Gill opening broad, reaching to below a point just before posterior preopercular margin. Jaws forming an angle of 35-40° with body axis, upper jaw 12.9-14.1% SL; upper margin of upper jaw in line with middle of eye (sometimes slightly below middle), extending posteriorly to below or before front of pupil or rarely to below middle of eye. Teeth in upper jaw: outer row of teeth conical, slightly enlarged

and wideset, 3-4 inner rows of smaller depressible, inwardly directed teeth, innermost row larger than middle row. Teeth in lower jaw: teeth in outer row conical, slightly enlarged and wideset anteriorly, 2-3 inner rows of smaller depressible teeth, those at side of jaw slightly enlarged and only slightly depressible. Gill rakers on outer face of first arch pointed and short; length about one-quarter gill filament length. Body covered mostly with large ctenoid scales, cycloid on pectoral base, prepelvic area, midline of belly, operculum and midline of predorsal (in adults); predorsal scales often ctenoid in young. First dorsal fin with oval to rounded margin, with third spine extending beyond other spines when fin depressed in male, third to fifth spines ending at approximately same point in females; dorsal origin behind pelvic insertion. Second dorsal fin subequal in height to first dorsal fin. Anal fin slightly lower than dorsal fins. Posterior dorsal and anal rays much shorter than anterior rays in females. Pectoral fin with rounded to slightly rounded posterior margin, reaching to above or just before anal origin. Pelvic disc broadly rounded, length slightly longer (1.2-1.4) than width; fifth ray heavily branched.

Head pores

Nasal pore often in front of and above anterior nostril, in juveniles around 35 mm SL, pore midway between nostrils;

anterior interorbital pore single, posterior interorbital pore single; postorbital pore behind eye present; infraorbital pore below postorbital; lateral canal pore above preoperculum; 1-2 (usually 2) lateral canal pores above operculum; terminal lateral canal pore above operculum; short tube above operculum, with pore at each end; 3 preopercular pores, upper in line with mideye to lower margin of pupil; widely separated from lower 2 (Fig. 2).

Papillae (Fig. 2)

Line 1 (before nasal pore) short and composed on single row of papillae. Line 2 (between nasal pores) composed of a single row of papillae, curved and short, line on each side of snout not meeting on midline. Line 5 (suborbital) composed of single row of papillae, joining other papillae anteriorly just below front of eye. Line 6 (suborbital branch) a short line composed of 1 row of papillae. Lines 7, 9, 10 (VL cheek rows) each a single row reaching posterior preopercular margin. Line 8 (VT row) reaching almost to posterior preopercular margin. Line 11 (VT row) reaching to near posterior preopercular margin. Line 12 (Outer POP-mandibular) composed of single row posteriorly, single or double adjacent to posterior end of lower jaw, and double anteriorly near anterior end of upper jaw, usually with gap behind end of jaws, papilla line often curved before and after gap, sometimes no gap. Line 13 (Inner POP-mandibular) single row, sometimes appearing double adjacent to lower jaw, no gap at end of lower jaw. Line 20 (OP VT) composed of single row dorsally, often double ventrally, with multiple branching ventrally (line 23). Line 21 (Upper OT) straight or curved single row without branches. Line 22 (Lower OT) short single row. Several vertical papillae rows on belly. A single curved line anteriorly on most body scales, often obscure dorsally and posteriorly.

Coloration in alcohol

Head and body brown, juveniles less than 50 mm SL usually light brown, adults usually dark brown to black dorsally and light brown ventrally. Head with extensive mottling and spotting around eye and dorsally on cheek and snout, laterally and ventrally on snout 2-3 longitudinal dark stripes (each often broken into 2 or more short stripes); adults over 60 mm SL often with dark brown to black covering chin, juveniles with black mainly on mental fraenum and sides of chin. Lips with dark brown and white mottling, white to light brown posteriorly. Pectoral base with a one to three dark brown blotches dorsally. Body with numerous (6-8) dark faint brown thin stripes, most distinctive along and just below midside; midside with a series of oval, horizontal, dark brown spots (usually covering 3 midline scales and about half of scale row above and below midside) sometimes alternating with small, brown spots (rectangular, square or slightly oval), oval spots sometimes connected to dark brown

spots on scale row above and below midside, giving bar an irregular margin; first large oval spot below first dorsal fin, usually broken into two short spots and with 3 dark brown, vertical bars extending ventrally from spots; second oval spot beginning below second dorsal origin, third below posterior half of second dorsal fin, one on middle of caudal peduncle and last at posterior end of caudal peduncle, extending onto base of caudal fin; midside spots often bordered above and below by narrow black stripe. First dorsal fin with few faint spots anteriorly, spines brown, with 3-4 rows of dark brown spots, membranes with some scattered black pigment, black pigment surrounds distal half of sixth dorsal spine forming an indistinct blotch, but not distinct spot, with well defined edges; second dorsal fin with 3-5 rows of brown spots (when erect spots in horizontal line, but when slightly depressed, spots appear to form oblique stripes); caudal fin with 6-8 wavy rows of dark brown spots dorsally, fin light brown to gray ventrally, without spots. Anal fin light brown to gray, with a white distal margin in adults over 50 mm SL. Pectoral fins white to brown, with dark brown spots basally forming wavy bands. Pelvic fins white to gray, with white distal margin in adults.

Distribution

This species is known from Sri Lanka to Indonesia (Sulawesi, Halmahera, Sumbawa and northern Papua), where it is sympatric with *Glossogobius illimis* (Fig. 13).

Similarity to other species

This species is easily distinguished from all species except *Glossogobius illimis* on the basis of the extra lateral canal pores above the operculum. It is also distinctive by the combination of the lobed mental fraenum, presence of papilla line 6 and the elongate dash-like black marks on midside. It differs from *G. illimis* in having I, 8 second dorsal rays (versus I, 9) and a slightly longer snout. The species also differs from *G. illimis* in coloration (see comparison under that species).

***Glossogobius illimis* n. sp.**

(Figs. 3, 4, 5, 14; Tab. I)

Glossogobius sp. 1. - Allen *et al.* 2002: 269 (Queensland, Australia)

Glossogobius celebius. - Allen, 1991: 180 (New Guinea); Senou *et al.*, 2004: 217 (Japan).

Glossogobius cf. *celebius*. - Marquet *et al.*, 2003: 222 (New Caledonia).

Material examined

Holotype. - AMS I.21272-010, 63 mm SL male, north of Cooktown, Queensland, 15°26' S, 11 Sept. 1979, D. Hoese.

Paratypes. - **Queensland, Australia:** AMS I.21254-001, 8(17-34), Noahs Beach, Cape Tribulation, 16°06'S, 145°28'E, 10 Sept. 1979, D. Hoese; AMS I.21256-009, 5(21-29), Cape Tribulation, 16°05'S, 145°28'E, 10 Sept. 1979, D. Hoese; AMS I.21272-002, 18(26-62), taken with holotype; AMS I.22056-006, 69(13-35), Bailey Creek, Endeavour River, north of Cape Tribulation, 17 Sept. 1980, D. Hoese; NTM S.13651-001, 4(47-76), South Johnstone River, Innisfail, 17°38'S, 145°46'E, 4 Aug. 1991, B. Pusey; NTM S.14186-001, 3(75-82), Hutchinson Creek, Cape Tribulation, 16°13.2'S, 145°25.2'E, 22 Aug. 1993, B. Pusey; NTM S.14187-002, 4(41-88), Daintree River, 16°09.6'S, 145°16.6'E, 28 Aug. 1993, B. Pusey; NTM S.14188-001, 2(54-68), Daintree River, 16°09.9'S, 145°16.6'E, 27 Aug. 1993, B. Pusey; NTM S.14191-001, 4(39-79), Daintree River, Douglas Creek, 16°15.4'S, 145°18.5'E, 1 Sept. 1993, B. Pusey; QM I.29371, 2(59-91), Harvey Creek, tributary of Russell River, 17°15.6'S, 145°55.39'E, 17 April 1994, P. Graham; QM I.29398, 3(88.5-104), Behana Creek, tributary of Mulgrave River, 17°09'S, 145°49'E, 13 Jul. 1994, P. Graham; QM I.29989, 3(29, 65, 66), Liverpool Creek, 17°42'S, 146°05'E, 2 Aug. 1994, P. Hales; QM I.30836, 4(24-32), 18°19'S, 146°14'E, 17 Oct. 1996, P. Graham; QM I.32871, 2(64-67), Freshwater Creek, Cairns, 16°53'S, 145°42'E, 9 May 1997, A. McDougall; QM I.37560, 1(59), North Johnstone River, 17°30'S, 146°00'E, 26 Jul. 2005; WAM P.26944-004, 1(43), Endeavour River, west of Cooktown, 15°25'S, 145°04'E, 2 Sept. 1980, G. Allen; WAM P.26955-[ex 007], 1(23), Mowbray River, near Mossman, 16°34'S, 145°27'E, 13 Sept. 1980, G. Allen & D. Hoese. **Papua New Guinea:** AMS IA.6340, 1(101), South Bougainville Island, Solomon Islands, 6°40'S, 155°45'E; CAS 63547, 16(28-54), Golgol River, Madang Province, channel on northern bank, approximately 2 km east of where it is crossed by Lae-Madang Road, 2 Jul. 1996, L. Parenti & J. Mizeu; WAM P.28185-005, 33(28-86), small creek 25 km S of Kavieng, New Ireland, 2°46'S, 151°03'E, 14 Oct. 1983, G. Allen & R. Steene.

Non-type material. - **Japan: Ryukyu Islands** (Iriomote Island): AMS I.23503-001, Nakama River, 24°30'N, 124°40'E; NSMT-P.67356, Nakara-gawa River. **Palau (Babelthup Island):** AMS I.19656-002, Ghimel River; CAS 50977, Arakitaoh stream, 7°23.37'N, 134°31.4'E; CAS 56375, Arakitaoh stream, 7°23.33'N, 134°31.22'E; CAS 88335, Amekaud River, mangrove zone, 7°33.77'N, 134°33.13'E; CAS 88339, Arakitaoh stream, 7°23.4'N, 134°31.12'E; CAS 88331, Ilmaw stream, 07°21.62'N, 134°31.32'E; CAS 88333, Kuad stream, mangrove zone, 7°23.08'N, 134°35.42'E. **Pohnpei, Micronesia:** USNM 223259, river just below Jokaj Waterfall, 6°57'N, 158°12'E. **Kosrae, Micronesia:** BMNH 78.5.22:119, (as Oualan); BPBM 28322, Tafuyat River at old reservoir. **Philippines:** CAS-SU 29836, Tanjay, Negros; CAS-SU 33087, Bauang River, La Union Province; CAS-SU 38524, Dumaguete, Negros Oriental. **Sabah, Borneo:** ZRC 30407, about 10 km from Koa Belud-Ranau. **Thailand:** CAS 88314, Klong Sone stream, by Aoa Klong Sone Bay, N end of Koh Chang Island; CAS 88325, Kong Chao stream, Aoa Kong, Chow Bay, west side of Goh Kut Island. **Malaysia:** NSMT-P.65173, Kg

Juara, Tioman Island. **Indonesia: Papua Barat** (West Papua Province): WAM P.31034-009 and WAM P.31037-016, Reifafeif River, Yapen Island, 1°50'S, 136°31'E; WAM P.31039-004, Mendori Creek, Yapen Island, 1°51'S, 136°31'E; WAM P.31041-005, Yapen Island, 1°51'S, 136°33'E; WAM P.31060-002, Krimpon River, 2°27'S, 140°23'E; WAM P.31302, Etna Bay, 3°57'S, 134°59'E; WAM P.31459-015, Wapoga River, 2°42.63'S, 136.08'E; WAM P.31466-003, Waigeo Island, Raja Ampat Islands, 0°17'S, 30°57'E; WAM P.31469-004, Salawati, Raja Ampat Islands; WAM P.31550-004, Fakal Village, Raja Ampat Islands; WAM P.31551-[ex 007], Misool Island, Raja Ampat Islands, 1°59'S, 129°55'E; WAM P.31552-003, Misool Island, Raja Ampat Islands. **Bougainville Is., Papua New Guinea:** AMS I.380, Buin; QM I.31033; WAM P.28164-006, Tekan River, 5°57'S, 155°20'E. **New Britain, Papua New Guinea:** WAM P.31148-002 and WAM P.31151-002, Kimbe Bay. **Papua Manus Island, New Guinea:** USNM 114890, Tei-ei River; WAM P.27829-005, 2°02'S, 147°17'E; WAM P.27830-003, Lorengau River, 2°02'S, 147°16'E. **Papua New Guinea Mainland:** AMS I.39584-004, Kamiali village, Morobe Province, 7°19.53'S, 147°07.49'E; BMNH 1983.8.2:27, BMNH 1983.8.2:88-90 and BMNH 1983.8.2:136-140, Madang; CAS 63563, Palpa River, 5°25'S, 145°45'E; CAS 88231, Ramu River, 4°14'S, 144°41'E; WAM P.27403-009, Burep River System, 6°41'S, 147°06'E; WAM P.27786-014, mangrove creek at Oro Bay, 8°54'S, 148°29'E; WAM P.27833-009, Mandi Stream, 15 km southeast of Wewak, 3°38'S, 43°43'E; WAM P.29596-002, Madang, 5°07'S, 145°47'E; WAM P.29602-016, Golgol River, 45 km upstream, 5°20'S, 145°38'E; WAM P.29613-008, Bogia, 4°13'S, 44°55'E; WAM P.32353-002, Mebulibuli River, 9°31'S, 152°52'E; WAM P.32357-001, Wandala River, 9°22'S, 150°21'E. **Queensland, Australia:** AMS I.21252-002, Freshwater Creek, Cairns, 16°56'S, 145°42'E; AMS I.21256-002, Cape Tribulation, 16°05'S, 145°28'E; AMS I.21419-004, Creek S of Cairns Harbour, 16°57'S, 145°48'E; AMS I.23832-001, Ollera Creek, near Cooktown, 15°29'S, 145°15'E; AMS IB.3583, Townsville, 19°16'S, 146°49'E; CSIRO B.1528, Townsville; NTM S.13645-001, Mulgrave River, 17°19'S, 45°148'S; NTM S.13647-001, Little Mulgrave River, 17°09'S, 145°45'E; NTM S.13648-001, Lower Mulgrave River, 17°06'S, 145°47'S; NTM S.13650-001, Behana Creek, Aloomba, 17°07'S, 145°50'E; NTM S.13652-001, South Johnstone River, near Innisfail, 17°38'S, 145°46'E; NTM S.13654-001, Stewart Creek, 17°38'S, 145°50'E; NTM S.14185-001, Cooper Creek, Cape Tribulation, 16°10.5'S, 145°25.1'E; NTM S.14189-001, Daintree River, Landers Creek, 16°10.6'S, 145°16.6'E; NTM S.14190-001, Daintree River, Douglas Creek, 16°16.9'S, 145°17.6'E; NTM S.14193-001, Daintree River, Stewart Creek, 16°17.66'S, 145°19.04'E; NTM S.14195-002, Bloomfield River, Granite Creek, 15°56.3'S, 145°19.5'E; NTM S.14196-001, Noah Creek, Cape Tribulation, 16°10.5'S, 145°25'E; NTM S.14197-002, Barron River, 16°52.5'S, 145°40.9'E; NTM S.14200-001, Tully River, 17°48'S, 145°41.1'E; QM I.13300, Little Ramsay Bay, Hinchinbrook Island, 18°17'S, 146°15'E; QM I.20470, Barretts Creek, Daintree River, 16°15'S, 145°20'S; QM I.21971, Daintree River, at Daintree, 16°15'S, 145°19'E; QM I.22694,

Figure 3. - *Glossogobius illimis*, AMS I.21272-010, 63 mm SL, holotype, near Cooktown, Queensland, Australia.



Between Bloomfield and Daintree; QM I.28724, Utchee Creek., South Johnstone River, 17°37'S, 145°58'S; QM I.30624, Hinchinbrook Island, Boyds Creek., Deluge Inlet, 18°26'S, 146°15'E; QM I.31243, Freshwater Creek, tributary of Barron River, 16°53'S, 145°42'E; QM I.31258, Stoney Creek, tributary of Barron River, 16°52'S, 145°40'E; QM I.32991, North Johnstone River, 17°30'S, 149°59'E; QM I.34760, Mulgrave River, 17°08'S, 145°52'E; QM I.35388, Banyan Cree mouth, Tully River, 18°00'S, 145°55'E; WAM P.26946-013, Starcke River, 14°49'S, 144°58'E; WAM P.28545-004, Hilda Creek, 16°09'S, 145°17'E; WAM P.28546-015, Cooper Creek, 16°11'S, 145°25'E. **New Caledonia:** AMS IB.2250; MNHN 1996-429, MNHN 1996-430 and MNHN 1996-441, east coast. **Fiji:** AMS I.43171-001, Viti Levu, Savura, below dam, 18°05'S, 178°26,54'E. **Vanuatu:** NMNZ P.36860, Efate.

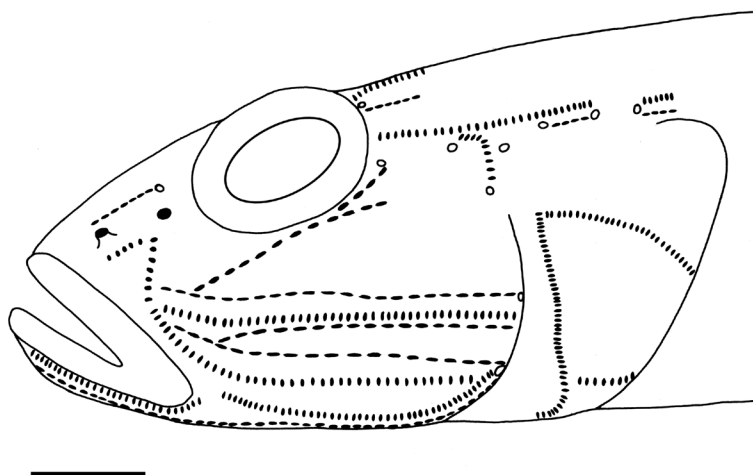


Figure 4. - *Glossogobius illimis*, composite drawing of sensory papillae, based on holotype and other Australian material. Scale = 5 mm.

Diagnosis

Mouth moderate; reaching to a point below anterior margin to middle of eye; operculum with a small patch of scales dorsally with 10-20 small scales in two or three longitudinal rows; second dorsal rays usually I,9; pectoral rays 18-21 (usually 20); predorsal scale count usually 13-18; one or usually two small lateral canal head pores above anterior operculum just before terminal lateral canal pore; papilla line 6 usually well developed; papilla lines composed of a single row of papillae; body with 5 elongate brown to black spots on midside from second dorsal origin to posterior end of caudal peduncle; snout length 9.8-11.3% SL; spots usually bordered by faint brown lines above and below.

Description

Counts and measurements based on 80 specimens, with over 600 specimens 13-110 mm SL examined. First dorsal spines 6(80*); second dorsal rays I,8(3), I,9(77*), I,10(1); anal rays I,8(81*); longitudinal scale count 28(4), 29(18*), 30(31), 31(5); predorsal scale count 13(2), 14(9), 15(26*), 16(17), 17(4), 18(3); transverse scale count (TRB) 8.5(27), 9.5(30*), 10.5(1); gill rakers on outer face of first arch 1+1+6(1), 1+1+7(17), 1+1+8(32), 1+1+9(6), 2+1+7(2), 2+1+8(2), 2+1+9(1); 2+0+8(1); lower gill rakers on outer face of second arch 6(7), 7(37), 8(17), 9(4); segmented caudal rays 16(1), 17(66*); branched caudal rays in specimens

below 40 mm SL 6/6(14), 7/6(1); in specimens 40-103 mm SL 6/6(34), 7/6(9*), 7/7(2), 8/7(1); vertebrae 10+16(1), 10+17(10). Pectoral ray counts are show in table I.

Head slightly depressed, 29.0-31.0% SL. Snout rounded in dorsal view; convex in side view; Eye moderate about two-thirds length of snout, 6.7-8.4% SL. Small bump below anterior nostril distinct. Anterior nostril at end of short tube, 1-2 nostril diameters above upper lip. Posterior nostril with raised rim, midway between eye and anterior nostril. Preoperculum short, with a small broad flat and rounded to pointed projection at angle; distance from end of eye to upper posterior preopercular one-half to three-quarters of snout length. Postorbital moderate, length subequal to distance from tip of snout to a point between anterior margin and middle of eye. Gill opening broad, reaching to below a point just before posterior preopercular margin. Jaws forming an angle of 35-40° with body axis; upper margin of upper jaw in line with middle of eye (sometimes slightly below middle); upper jaw 12.3-14.1% SL. Teeth in upper jaw: outer row of teeth conical, slightly enlarged and wideset, 3-4 inner rows of smaller depressible, inwardly directed teeth, innermost row larger than middle row. Teeth in lower jaw: teeth in outer row conical, slightly enlarged and wideset anteriorly, 2-3 inner rows of smaller depressible teeth, those at side of jaw slightly enlarged and only slightly depressible. Gill rakers on outer face of first arch short and pointed; length about



Figure 5. - *Glossogobius illimis*, ZRC 30704, 63 mm SL, Sabah, Borneo.



Figure 6. - *Glossogobius* cf. *illimis*, AMS I.45369-009, 78 mm SL, New Britain.



Figure 7. - *Glossogobius* cf. *illimis*, WAM P.31352-012, 84 mm SL, Lakekamu, New Guinea.

one-quarter gill filament length. Body covered mostly with large ctenoid scales, cycloid on pectoral base, prepelvic area, midline of belly, operculum and midline of predorsal (in adults), predorsal scales often ctenoid in young. First dorsal fin with third spine extending beyond other spines when fin depressed in male, third to fifth spines ending at approximately same point in females, origin behind pelvic insertion. Second dorsal fin subequal in height to first dorsal fin. Anal fin slightly lower than dorsal fins. Posterior dorsal and anal rays much shorter than anterior rays in females. Pectoral fin with rounded to slightly rounded posterior margin, reaching to above or just behind anal origin. Pelvic disc broadly rounded, length subequal to or slightly longer (1.0-1.2) than width; reaching to near to anus; fifth ray heavily branched.

Head pores

Nasal pore in front of posterior nostril and above anterior nostril; anterior interorbital pore single, posterior interorbital pore single; postorbital pore behind eye present; infraorbital pore below postorbital; lateral canal pore above pre-

operculum; 1-2 (usually 2) lateral canal pores above operculum; terminal lateral canal pore above operculum; short tube above operculum, with pore at each end; 3 preopercular pores, upper in line with mideye to lower margin of pupil; widely separated from lower 2 (Fig. 4).

Papillae (Fig. 4)

Line 1 (before nasal pore) short and composed on single row of papillae. Line 2 (between nasal pores) composed of a single row of papillae, curved and short, line on each side of snout not meeting on midline. Line 5 (suborbital) composed of single row of papillae, joining other papillae anteriorly just below front of eye. Line 6 (suborbital branch) a short line composed of single row of papillae, often appearing as a broken line paralleling line 5 and often absent (usually on only one side of head) in juveniles below 31 mm SL. Lines 7, 9, 10 (VL cheek rows) each a single row reaching posterior preopercular margin. Line 8 (VT row) reaching almost to posterior preopercular margin. Line 11 (VT row) reaching to near posterior preopercular margin. Line 12 (Outer POP-

mandibular) composed of single row posteriorly, single or double adjacent to posterior end of lower jaw, and double anteriorly near anterior end of upper jaw, usually with gap behind end of jaws, papilla line often curved before and after gap, sometimes no gap. Line 13 (Inner POP-mandibular) single row, sometimes appearing double adjacent to lower jaw, no gap at end of lower jaw. Line 20 (OP VT) composed of single row, with multiple branching ventrally (line 23). Line 21 (Upper OT) curved single row without branches. Line 22 (Lower OT) short single row. Several vertical papillae rows on belly. A single curved line anteriorly on most body scales (often obscure dorsally and posteriorly).

Coloration in alcohol

Head and body brown, juveniles, less than 50 mm SL, usually light brown, adults usually dark brown dorsally and light brown ventrally. Head with extensive mottling and spotting around eye and dorsally on cheek and snout, laterally and ventrally on snout 2-3 longitudinal dark stripes (each often broken into 2 or more short stripes); adults over 60 mm SL with dark brown to black covering chin, juveniles with black mainly on mental fraenum and sides of chin. Pectoral base with a short brown stripe dorsally, followed by and sometimes confluent with an oblique brown bar. Body with numerous (6-9) dark brown thin stripes (sometimes obscure ventrally); midside with a series of rectangular, horizontal, dark brown bars (usually covering 4 midline scales anteriorly and 3-4 posteriorly) alternating with small, brown spots (rectangular, square or slightly oval); first large rectangular stripe below first dorsal fin, second beginning below second dorsal origin, third below posterior half of second dorsal fin, one on middle of caudal peduncle and last at posterior end of caudal peduncle, extending onto base of caudal fin; midside spots often bordered above and below by narrow black stripe; back with large dark oblique saddles, sloping forward, first below first dorsal fin second below anterior quarter of first dorsal fin, third below posterior end of second dorsal fin and a small blotch near end of caudal peduncle. First dorsal fin with few faint spots anteriorly, rarely with a black spot about equal to pupil diameter surrounding sixth spine distally; second dorsal fin with 3-5 rows of brown spots (when erect spots in horizontal line, but when slightly depressed, spots appear to form oblique stripes); caudal fin with 6-8 wavy rows of dark brown spots dorsally, fin light brown to gray ventrally, without spots. Anal fin light brown to gray. Pectoral fin with dark brown spots basally forming wavy bands. Pelvic fins light brown to gray.

Distribution

This species is widely distributed in coastal rivers from Japan to eastern Australia, extending eastward to Kosrae and Pohnpei in the eastern Caroline Islands (Fig. 14). It is particularly common in clear streams on islands in the western

tropical Pacific. It has typically been misidentified as *Glossogobius celebius*.

Similarity to other species

This species is easily distinguished from all species except *Glossogobius celebius* on the basis of the extra lateral canal pore above the operculum. It is also distinctive by the combination of the lobed mental fraenum, presence of papilla line 6 and elongate dash-like black marks on midside. It differs from *G. celebius* in having the second dorsal count of I,9 (versus I,8) and a shorter snout. These species are largely allopatric through much of their range, with *G. celebius* ranging from the Sri Lanka and the Andaman Islands to Indonesia and *G. illimis* occurring farther east. However, *G. illimis* does occur in Thailand and both species occur on islands in extreme northwest regions of Papua Barat. Second dorsal ray counts are consistent over a very large area for both species and mixed counts are only found in parts of Sulawesi eastward to Misool Island, Papua Barat. Counts of 30 specimens from Manus Island east of that area show only one specimen with a second dorsal count of I, 8. Although both species exhibit considerable variation in coloration, the species can generally be separated on coloration where they occur together. In *Glossogobius celebius* the spots on the midline of the side are oval, usually vertically covering more than one scale row and covering only 2-3 longitudinal scales, while in *G. illimis*, the spots are rectangular covering only a single vertical row of scales on the midline and 3-4 horizontal scales. Also in *G. celebius* there are small black spots on the sides of the belly, which are usually lacking in *G. illimis*.

Remarks

One specimen from Sabah (ZRC 30704) is unusual in having spots on the midside dominating over the stripes (Fig. 5). Other specimens occasionally show a similar coloration. The specimen has 2 small accessory pores above the operculum on the right side of the head and one on the left side. Otherwise the specimen has the same characters as typical *G. illimis*. Two other specimens are tentatively included in this species. One is from the Kulu River in New Britain. The specimen (AMS I.45369-009, a 78 mm SL male) has only a single extra lateral canal pore above the operculum, a common condition in *G. illimis* (Fig. 6). However the specimen has distinctive bands on the body, a prominent black spot surrounding the sixth dorsal spine and the predorsal scales ending above the posterior preopercular margin. A similarly coloured specimen (WAM P.31352-012, an 84 mm SL male) from Lakekamu in southern Papua New Guinea from around 200 m elevation, also only a single extra lateral canal pore above the operculum, rather than two, but does have predorsal scales reaching to the eye (Fig. 7). However, it lacks papilla line 6, a rare condition in *Glossogobius*

illimis. At present no other specimens of *Glossogobius illimis* are known from southern Papua New Guinea. *Glossogobius illimis* frequently has only one extra single pore above the operculum. Specimens from Queensland sometimes have the spot on the first dorsal fin and it may be related to breeding. Tentatively we treat these specimens here as variants of *G. illimis*, but it is likely that these may represent distinct species. Because of the high individual variation in the species of *Glossogobius*, we are not prepared to describe these as distinct species until additional material becomes available.

Etymology

From the Latin *illimis* = without mud or clear, referring to the habitat of sandy clear streams.

Glossogobius munroi n. sp.

(Figs 8, 9, 10, 13; Tabs I, II)

Glossogobius aureus. - Akihito and Meguro, 1975: 128 (in part, non-type material, northern Australia).

Glossogobius giuris. - Roberts, 1978: 61 (in part, Fly River).

Glossogobius sp. 1. - Allen, 1991: 183, pl. 16, Fig. 12 (Papua New Guinea); Allen *et al.*, 2000: 124 (southern New Guinea).

Glossogobius sp. 2. - Allen *et al.*, 2002: 270 (northern Australia and southern New Guinea).

Glossogobius species. - Allen *et al.* 2008: 169 (Fly River, Papua New Guinea).

Material examined

Holotype. - AMS I.23267-015, 70 mm SL female, Wenlock River, Stone Crossing, Queensland, 12° 23'S, 142° 11'E, 6 Oct. 1982, D. Hoese & D. Rennis.

Paratypes. - **Papua, Indonesia**: RMNH 28487, 2(76-84), Digul River, near Merah, 10 Sept. 1959; WAM P.29953-006, 6(33-75), Bintuni River, 2°05'S, 133°26'E, 18 Mar., 1989, G. Allen; WAM P.29965-001, 9(48-106), Manimeri Log Camp, 2°06'S, 133°45'E, 27 Mar., 1989, G. Allen; WAM P.29973-009, 1(40), Bintuni River, Bintuni, 2°05'S, 133°22'E, 5 Apr., 1989, G. Allen. **Papua New Guinea**: USNM [ex. 217250], 43(17-104), Fly River, Tidal Creek on right side of Fly, 1 km upstream from D'Albertis Island, upriver from Toro Pass, 8°12.9'S, 142°03.9'E, 13 Dec. 1975, T. Roberts; WAM P.28150-012, 1(79), Fly River System, 10 km upstream of Cassowary Island, 7°52'S, 141°50'E, 15 Sept. 1983, G. Allen & D. Balloch; WAM P.28151-001, 5(29-63), Fly River System, about 1 km up Burrei River, 8°12'S, 142°01'E, 16 Sept. 1983, G. Allen & A. Maie. **Western Australia**: AMS I.19649-005, 1(75), Upper Prince Regent River, Kimberley District, 15°49'S, 125°39'E, 20 Aug. 1974, G. Allen; AMS I.25537-001, 12(36-83), Pentecost River, 15°48'S, 127°53'E, 27 Sept. 1985, D. Hoese & D. Ren-

nis; WAM P.21187, 1(36), Ord River, Stockyard Pool, 16°20'S, 128°50'E, 4 Oct. 1971, R. McKay & J. Dell; WAM P.25031-001, 1(65), Upper Prince Regent River, 15°50'S, 125°39'E, 20 Aug. 1974, G. Allen; WAM P.25032-001, 10(65-85), Upper Prince Regent River, 15°50'S, 125°35'E, 21 Aug. 1974, G. Allen. **Northern Territory, Australia**: AMS I.16859-005, 2(78-80), South Alligator River, 12°40'S, 132°55'E, July 1972, D. Pollard & M. Mann; AMS I.20850-017, 1(73), Victoria River system, 15°38'S, 130°23'E, 12 June 1978, D. Hoese & H. Larson; AMS I.20892-002, 1(70), Adelaide River, 13°14'S, 131°06'E, 24 June 1978, D. Hoese & H. Larson; AMS I.20905-001, 1(44), McKinley River, 12°58'S, 131°40'E, 20 Sept. 1978, R. Sadlier & G. Webb; AMS I.21891-002, 53(26-43), Magela Creek, 12°42'S, 132°57'E, 29 Dec. 1979, H. Midgley; AMS I.24683-004, 3(52-68), Blackmore River, Darwin, 13°43'S, 130°52'E, 1984, S. Reader, D. Hoese & D. Beechey; AMS I.24692-014, 1(69), Leaders Creek, Darwin, 12°13'S, 131°05'E, 1984, S. Reader, D. Hoese & D. Beechey; NTM S.10871-003, 5(20-59), South Alligator River System, Cooper Creek, 12°03'S, 132°45'E, 28 Sept. 1972, S.H. Midgley; NTM S.10871-003, 5(20-59), South Alligator River System, Cooper Creek, 12°03'S, 132°45'E, 28 Sept. 1972, S.H. Midgley; NTM S.11213-005, 1(47), South Alligator River, Deaf Adder Creek, 13°09'S, 133°05'E, 7 June 1973, S.H. Midgley; WAM P.25890-007, 8(48-62), Mary River, Arnhem Highway crossing, 12°48'S, 131°38', 2 Sept. 1977, G. Allen *et al.* **Queensland, Australia**: AMS I.17942-011, 1(60), Saxby River, 28 Sept. 1967, J. Lake; AMS I.18245-002, 1(48), Gregory River, Riversleigh Station, 19°02'S, 138°44'E, 17 Apr. 1972, S.H. Midgley; AMS I.21059-002, 1(38), Cloncurry River, 20°32'S, 140°29'E, 1978, D. Hoese; AMS I.23267-001, 4(22-33), taken with holotype; AMS I.23269-002, 2(59-65), Wenlock River, Stone Crossing, 12°23'S, 142°11'E, 7 Oct. 1982, D. Hoese & D. Rennis; CSIRO A.3612, 1(70), Flinders River, Walkers Bend Crossing, 18°10'S, 140°52'E, 19 Oct., 1972, I.S.R. Munro & D.J. Tuma; CSIRO A.3963-3964, 2(71-83), Norman River, Glenore Crossing, 17°52'S, 141°08'E, 13 Oct. 1972, I.S.R. Munro; CSIRO B.1126, 32(15-68), Flinders River, Walkers Bend crossing, 18°10'S, 140°52'E, 19 Oct. 1972, I.S.R. Munro & D.J. Tuma; NTM S.13939-012, 2(29-31), Holroyd River, Silvers Hole, 14°26'S, 142°17'E, 21 Nov. 1993, B. Herbert; QM [ex. I.13302], 2(44-53), McArthur River, July 1975, S.H. Midgley; QM I.25120, 6(30-36), Albert River, Elizabeth Creek, Bowthorn Station, N.W., 18°13'S, 138°20'E, 21 Apr. 1988, J. Johnson; QM I.26745, 84(24-54), Archer River, 13°43'S, 142°02'E, Aug. 1988, S.H. Midgley; QM I.28174, 4(23-36), Coen River, Jaberoo Lagoon, 13°49'S, 142°50'E, 27 Nov. 1992, B. Herbert; QM I.28175, 2(51-55), Wenlock River, Stones Crossing, 12°23'S, 142°11'E, 21 Sept. 1992, B. Herbert; QM I.28176, 1(58), Wenlock River, south of Batavia Downs, 12°47'S, 142°49'E, 19 Aug. 1992, B. Herbert; QM I.31551, Mitchell River, 16°41.7'S, 145°12.3'E; WAM P.26326-004, 4(58-68), Leichhardt River, Leichhardt Falls, 18°07'S, 139°53'E, G. Allen and R. Steene.

Non-type material. - **Papua**: NTM S.15195-001, Lower Otakwa River. **Papua New Guinea**: AMS I.24639-002, Fly River,

Figure 8. - *Glossogobius munroi*, freshly collected holotype, AMS I.23267-015, 70 mm SL, Wenlock River, Queensland, Australia.



Delta, 8°30'S, 143°30'E; NTM S.14823-001, Steward Island, upper Fly River delta; NTM S.14825-001, Kiiwai Island, Fly River estuary; NTM S.14979-002, Puruth Channel, Fly River estuary; WAM P.28144-007, Ok Tedi River System, small Tributary 19 km NE of Ningerum on Ok Tedi River, 5°33'S, 141°16'E; WAM P.30977-014, Kikori River, Veiru Village, Waimake Creek, 7°26'S, 144°00'E. **Northern Territory, Australia:** AMS I.20890-004, Victoria River, Little Horse Creek, 15°38'S, 130°25'E; AMS I.32051-028, Alligator River, 12°08'S, 132°40'E; NMV A.10874, 10(26-46), Daly River, Below Daly River Crossing; NTM S.10720-005, East Alligator River, Cannon Hill Lagoon; NTM S.12624-012, Blyth River, road crossing, Arnhem Land, NTM S.12875-006, South Alligator River, Coronation Hill Mine, 13°35'S, 132°36'E; NTM S.12876-004, South Alligator River, Pool above El Sherana crossing, 13°32'S, 132°32'E; NTM S.14340-006, Wilton-Roper Rives. **Queensland, Australia:** AMS I.38528-007, Flinders River, 20°47'S, 144°04'E; CSIRO [ex. B.1129], Norman River, Rock pools above weir, Glenore crossing, 17°42'S, 141°16'E; NTM S.13632, Leichardt River, 19°22'S, 140°02'E; NTM S.14140-003, Saxby River, 19°26.38'S, 141°11.94'E.

Diagnosis

Mouth moderate; reaching to below anterior margin of eye; operculum with large patch of small mostly cycloid scales (10-20 scales) in 2 or 3 rows; pectoral base covered with small cycloid scales in adult, partly scaled to naked in specimens below 40 mm SL; first dorsal fin usually with small black spot posteriorly; second dorsal rays usually I,9; pectoral rays 18-22; predorsal scale count 18-24; no extra lateral canal pores above operculum; papilla line 6 absent; papilla lines composed of single row of papillae; body with a series of large spots on midside, each covering 2-3 scales in longitudinal direction on midside and one row above and

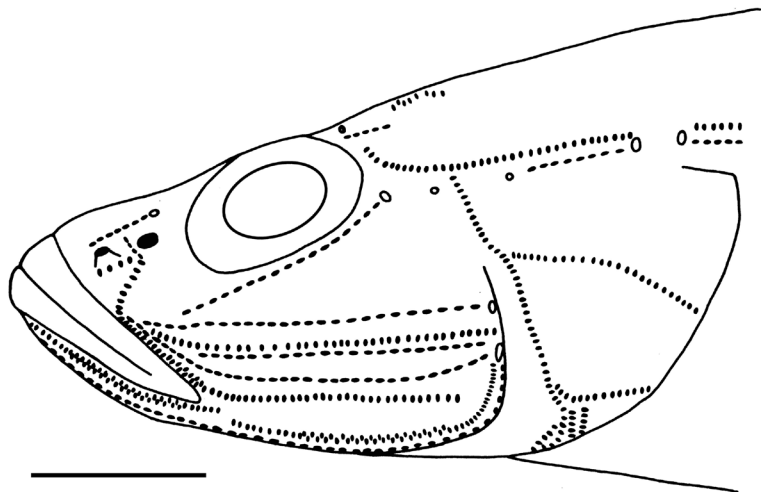


Figure 9. - *Glossogobius munroi*, composite drawing of sensory papillae, based on holotype and other Australian material. Scale = 5 mm.

one row below midside scales.

Description

Counts and measurements based on 106 specimens, with over 400 specimens, 18-106 mm SL examined. First dorsal spine 5(2), 6(104*); second dorsal rays I,8(3), I,9(106*); anal rays I,7(1), I,8(108*); longitudinal scale count 28(4), 29(16), 30(29*), 31(20), 32(5), 33(1); predorsal scale count (see Tab. 2); transverse scale count (TRB) 8.5(8), 9(6), 9.5(30*), 10(6), 10.5(16); gill rakers on outer face of first arch 0+1+7(1), 1+1+7(7), 1+1+8(14), 1+1+9(8), 2+1+8(4), 2+1+9(5); lower gill rakers on outer face of second arch 6(3), 7(30), 8(6), 9(1); segmented caudal rays 15(1), 16(2), 17(84*), 18(1), branched caudal rays in specimens below 40 mm SL 6/5(2), 6/6(11), 7/6(6); branched caudal rays in specimens 40-90 mm SL 6/6(2), 7/6(5), 7/7(23*); vertebrae 10+17(5), 11+16(1).

Figure 10. - *Glossogobius munroi*, NTM S.15195-001, 75 mm SL, New Guinea.



Table II. - Predorsal scale counts in *Glossogobius munroi* n. sp. from Australia and New Guinea.

	17	18	19	20	21	22	23	24	25	26	27	28
Australia	5	10	17	10	8	5	6*	1	2	–	–	–
New Guinea	–	–	–	3	7	12	12	5	–	–	–	1

Head depressed, 27.3–30.3% SL. Snout rounded in dorsal view; straight in side view, but often with slight notch before eye; 8.5–10.2% SL. Eye about two or less in snout, 5.6–6.8% SL. Small bump below anterior nostril present. Anterior nostril at end of short tube, just above upper lip. Posterior nostril with raised rim midway between eye and upper margin of upper lip, and about 2 nostril diameters from anterior nostril. Preoperculum with broad flat projection at angle below lower preopercular pore, preoperculum short, distance from end of eye to upper posterior preopercular margin subequal to eye. Postorbital long, subequal to distance from tip of snout to just before end of eye. Gill opening reaching to below a point just anterior to posterior preopercular margin. Jaws forming an angle of 35–40° with body axis; upper margin of upper jaw in line with lower margin of eye; upper jaw 8.7–11% SL in specimens less than 80 mm SL, 11.0–11.5 in specimens over 80 mm SL. Teeth in upper jaw: outer row of teeth conical, slightly enlarged and wideset, 3–4 inner rows of smaller depressible, inwardly directed teeth, innermost row larger than middle row. Teeth in lower jaw: teeth in outer row conical, slightly enlarged and wideset anteriorly, 2–3 inner rows of smaller depressible teeth, those at side of jaw slightly enlarged and only slightly depressible. Gill rakers on outer face of first arch slender; about one-third gill filament length. Body covered mostly with large ctenoid scales, cycloid on pectoral base, prepelvic area, midline of belly, most of opercular scales; predorsal scales cycloid on midline (Australian specimens) or largely ctenoid (New Guinea specimens); in small specimens less than 40 mm SL from Australia the naked patch behind the eye larger and extending to above the operculum in specimens of about 20 mm SL. Prepelvic area covered with small cycloid scales in adult, partly scaled posteriorly in specimens less than 60 mm SL. First dorsal fin with oval margin, spines 4–6 extending beyond other spines when fin depressed, not obviously sexually dimorphic in length. Second dorsal fin subequal in height to first dorsal fin. Anal fin slightly lower than second dorsal fin. Pectoral fin with rounded margin, reaching to above anus. Pelvic fin thin, longer than wide; reaching just short of anus; fifth pelvic ray with 4–6 terminal tips in specimens less than 40 mm SL and 14–18 in specimens greater than 70 mm SL.

Head pores

Nasal pore above and slightly forward of posterior nostril; anterior interorbital pore single; posterior interorbital pore single; postorbital pore behind eye present; infraorbital

pore below postorbital; lateral canal pore above preoperculum present; terminal lateral canal pore above anterior operculum; short tube above operculum, with pore at each end; 3 preopercular pores, upper in line with or just above lower margin of eye, mid preopercular pore slightly closer to lower pore than to upper pore (Fig. 9).

Papillae (Fig. 9)

Line 1 (before nasal pore) single row reaching almost to tip of snout. Line 2 (between nasal pores) single curved row, usually with gap middorsally. Line 5 (Suborbital) single row joining line 7 before eye. Line 6 (Suborbital branch) absent. Lines 7, 9, 10 (VL cheek rows) each a single row reaching posterior preopercular margin. Line 8 (VT row) usually reaching posterior preopercular margin. Line 11 (VT row) reaching to near, but short of posterior preopercular margin. Line 12 (Outer POP-mandibular) composed of single row usually with gap behind end of jaws. Line 13 (Inner POP-mandibular) single row. Line 20 (OP VT) single row, with multiple rows branching ventrally (line 23). Line 21 (Upper OT) curved single row without branches. Line 22 (Lower OT) short single row. Several vertical papillae rows on belly. A single curved line anteriorly on most body scales (often obscure dorsally and posteriorly).

Coloration in alcohol

Head and body brown. Head with small scattered dark brown spots; a broad stripe from anteroventral margin of eye to upper lip; a short stripe from posteroventral margin of eye extending onto cheek and curving posteriorly, a dark brown spot ventral to bar (sometimes connected to bar) on chin below posterior margin of eye; chin usually pale, except for dark brown lateral edges to mental fraenum, chin sometimes with scattered dark brown pigment; branchiostegal membranes light brown; lower lip with 3–5 oblique dark brown bars. Lips with dark brown and white mottling, white to light brown posteriorly. Body dark brown from midside dorsally and pale brown ventrally, with a series of 4–6 thin brown longitudinal stripes; dark brown to black spot above pectoral base. A series of large spots on midside, each covering 2–3 scales in longitudinal direction on midside and one row above and one row below midside scales covering 2–3 scales; first spot below anterior quarter of first dorsal fin, second below space between first dorsal insertion and second dorsal origin, third below posterior third of second dorsal fin, fourth on middle of caudal peduncle, fifth at posterior end of caudal peduncle, expanding into a vertical bar on caudal fin base; oblique brown bars extending dorsoposteriorly from midside spot onto back (often faint in Australian material); belly often with a dark brown spot extending ventrally from first midside spots. Horizontal bar dorsally on pectoral fin base. First dorsal fin with scattered black spots in 2–3 horizontal rows, posterior end of first dorsal fin often with larger black

spot between surrounding middle of sixth spine. Second dorsal fin with black spots forming 2-4 rows. Pectoral and caudal fins with brown spots forming wavy bands (usually 4-6) on dorsal two-thirds of fin, ventral two thirds grey. Anal fin whitish, often with 1-2 horizontal rows of small black spots, often grey, with a white distal margin; pelvic fins whitish, sometimes with scattered grey pigment.

Distribution

The species ranges from the Kimberley Region of Western Australia to the Wenlock River in the Gulf of Carpentaria in Queensland, Australia and occurs just west of the dividing range west of Port Douglas, but currently not known from rivers in eastern Queensland. It is also known from rivers of southern Papua and Papua New Guinea (Fig. 13). The species is only known from freshwater from about 1 km above tidal influence to 400 km inland.

Similarity to other species

This species frequently occurs with *Glossogobius aureus* in Papua New Guinea and with that species and *G. giuris* in Australia. Because of the lack of the suborbital papilla line 6, it is frequently confused with *G. aureus*. It differs from *G. aureus* and *G. giuris* in having a well-developed mental fraenum. The species also has a slightly shorter snout and fewer predorsal scale rows than does *G. aureus*. Specimens from New Guinea are easily distinguished from *G. aureus* by the ctenoid predorsal scales on the midline (cycloid in *G. aureus*). Dark individuals are most easily distinguished by the oblique brown bands extending posteroventrally from midlateral brown blotches. The species is similar to *G. celebius* in coloration and in the shape of the mental fraenum. It differs from that species and *G. illimis* in lacking the papilla line 6, having more predorsal scales and in having fewer lateral canal head pores. See comparison under *Glossogobius clitellus* n. sp. (this paper) for differences with that species.

Remarks

Specimens from New Guinea (Fig. 10) differ in several features from those from Australia (Fig. 8). The predorsal scales are ctenoid to the eyes in New Guinea specimens, while those from Australia are cycloid, and there is a narrow naked area behind the eye. New Guinea specimens also have distinct rectangular midlateral dark spots (usually covering 3 scale rows in horizontal direction), connected to a dark oblique bar extending dorsoposteriorly onto the back. In Australian specimens the midlateral spots are often irregular in shape (covering 2 scale rows) and sometimes lack the oblique bars on the back. New Guinea specimens also tend to have a slightly larger caudal peduncle spot. Specimens from few localities were examined from New Guinea, but pectoral rays and predorsal scale counts average higher in

New Guinea populations. Pectoral ray counts ranged from 19-23 (usually 21-22) in New Guinea specimens versus 17-21 (usually 18-20) in Australia (Tab. I) and predorsal scales in New Guinea specimens ranged from 20-24, while counts varied from 17-25 (usually less than 21) in Australia. Pectoral-ray counts vary considerably within Australia, with populations averaging 18, 19, 20 or 21 rays (Tab. I). One population from Darwin area was similar to the New Guinea populations in coloration, high pectoral (mostly 21 rays) and predorsal scale counts and largely ctenoid predorsal scales. However, two specimens have ctenoid scales on the posterior half of the predorsal area and cycloid scales on the anterior half. One population from Arnhem Land is similar in coloration to the New Guinea form, but has a mixture of cycloid and ctenoid scales on the predorsal area. Since temperatures are generally warmer in the Darwin area and Arnhem Land than in other areas sampled in Australia, it is distinctly possible that the features separating the New Guinea populations from most of those from Australia may be related to temperature.

Etymology

Named for Ian Munro, who collected and accumulated material of *Glossogobius* from Australia and New Guinea.

Glossogobius clitellus n. sp.

(Figs 11, 12, 13; Tab. I)

Glossogobius sp. 9. - Allen, 1991: 186. (Waigeo Island and Solomon Islands).

Material examined

Holotype. - WAM P.28164-005, 61 mm SL male, Papua New Guinea, Tekan River road crossing W of Arigua plantation, Bougainville, 5°57'S, 155°20'E, 3 Oct., 1983, G. Allen and R. Steene.

Paratypes. - **Papua New Guinea:** BMNH 1983.8.2:20, 1(86), Madang, D. Kershaw; BMNH 1983.8.2:91, 1(71), Madang, D. Kershaw; CAS 53259, 3(37-63), Solomon Islands, Guadalcanal; freshwater, pebbles and sand, quiet clear stream, 9°24.5'S, 159°53.75'E, 27 Sept. 1958, R. Bolin. **Papua Barat, Indonesia:** USNM 245214, 7(49-66), Tip Waigeo Island, between TG. Manganeki and TG. Boropen, 0°41.5' S, 133°19.5'E, 1 Jul. 1979, B.B. Collette *et al.* USNM 133186, 2(35-72). **Philippines:** Dumaguete River, Dumaguete, Negros Oriental, 21 Apr. 1946, D. Frey; ZRC 50315, 1(61), Philippines, Kawasan Falls, Matutiahao River, Cebu, 3 Jul. 2003, P. Ng *et al.*

Non-Type Material. - **Madang Papua New Guinea:** CAS 63489, 1(50); CAS 63567, 17(29-71).

Diagnosis

Mouth moderate; reaching to below mideye; operculum



Figure 11. - *Glossogobius clitellus*, holotype, WAM P.28164-005, 61 mm SL, Bougainville, New Guinea.

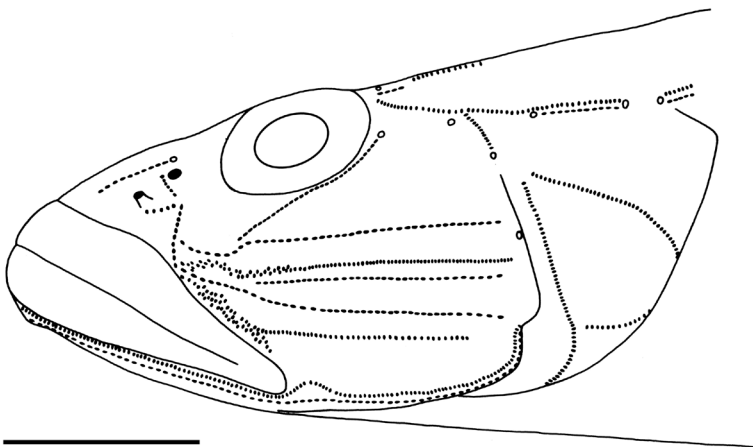


Figure 12. - *Glossogobius clitellus*, composite drawing of sensory papillae, based on holotype and paratypes. Scale = 5 mm.

with a small patch of 3-7 cycloid scales dorsally; second dorsal I,9; pectoral rays 18-20 (usually 19); predorsal scale count 14-17; lateral canal short, ending above posterior preopercular margin, only one pore above preoperculum and the terminal pore; papilla line 6 absent; body with dark saddles dorsally and no dark lines on midside; first dorsal fin in males with a small black spot posteriorly behind fifth dorsal spine to end of fin, females without spot.

Description

Counts and measurements based on 18 specimens, with 33 in total examined, 29-86 mm SL. First dorsal spines 5(1), 6(17*); second dorsal rays I,8(1), I,9(11*); anal rays I,8(12*); predorsal scale count 14(3), 15(6), 16(5*), 17(3), 18(1); longitudinal scale count 28(3), 29(9*), 30(5), 31(1); transverse scale count 8.5(5), 9.5(13*); gill rakers on outer face of first arch 1+1+8(5), 1+1+9(1), 2+1+7(2), 2+1+8(2), 2+1+9(5*); segmented caudal rays 9/8(18*); branched caudal rays 6/6(15), 7/6(2), 7/7(1); vertebrae 10+17(12). Pectoral rays given in table I.

Head depressed, tapering anteriorly, 31.8-36.8% SL. Snout long, pointed in dorsal view, gently convex in side view; 9.7-10.4% SL. Eye about 1.5-2 in snout, 6.4-6.6% SL. Small bump below anterior nostril present. Anterior nostril at end of short tube, 2 nostril diameters above upper lip. Posterior nostril closer to eye than to lips, 2 nostril diameters

from eye and 2 from anterior nostril. Preoperculum short, without spine, but with blunt projection near angle, below lower preopercular pore, distance from end of eye to upper posterior preopercular margin subequal to or shorter than eye. Postorbital long, subequal to distance from tip of snout to posterior half of eye. Gill opening reaching to below a point just in front of posterior preopercular margin. Jaws forming an angle of 40-45° with body axis; upper margin of upper jaw in line with a point just below mideye. Teeth in upper jaw: outer row of teeth conical slightly enlarged and wideset, 2-3 inner rows of smaller depressible, inwardly directed teeth, innermost row larger than middle row(s). Teeth in lower jaw: teeth in outer row conical, slightly enlarged and wideset anteriorly, 2-3 inner rows of smaller depressible teeth, innermost row slightly larger than middle row(s). Gill rakers on outer face of first arch long and slender; about one-third to one-half filament length. Body covered mostly with large ctenoid scales, cycloid anteriorly on predorsal region, pectoral base, prepelvic area and midline of belly. First dorsal fin with rounded margin, fin spines 3-5 (or 2-4) extending beyond other spines when fin depressed, origin well behind pelvic insertion. Second dorsal fin subequal in height to first dorsal fin. Anal fin slightly lower than second dorsal fin. Pectoral fin with acutely rounded margin, reaching to above anal origin. Pelvic disc thin, oval, length greater than width; fifth ray with 12-16 terminal tips.

Head pores

Nasal pore above anterior nostril and before posterior nostril; anterior interorbital pore single posterior interorbital pore single; postorbital pore behind eye present; infraorbital pore below postorbital present; lateral canal pore above preoperculum present; lateral canal pore above posterior preopercular margin absent; terminal lateral canal pore above anterior operculum present; short tube above operculum, with pore at each end present; 3 preopercular pores, upper in line with lower margin of pupil; widely separated from lower 2 (Fig. 12).

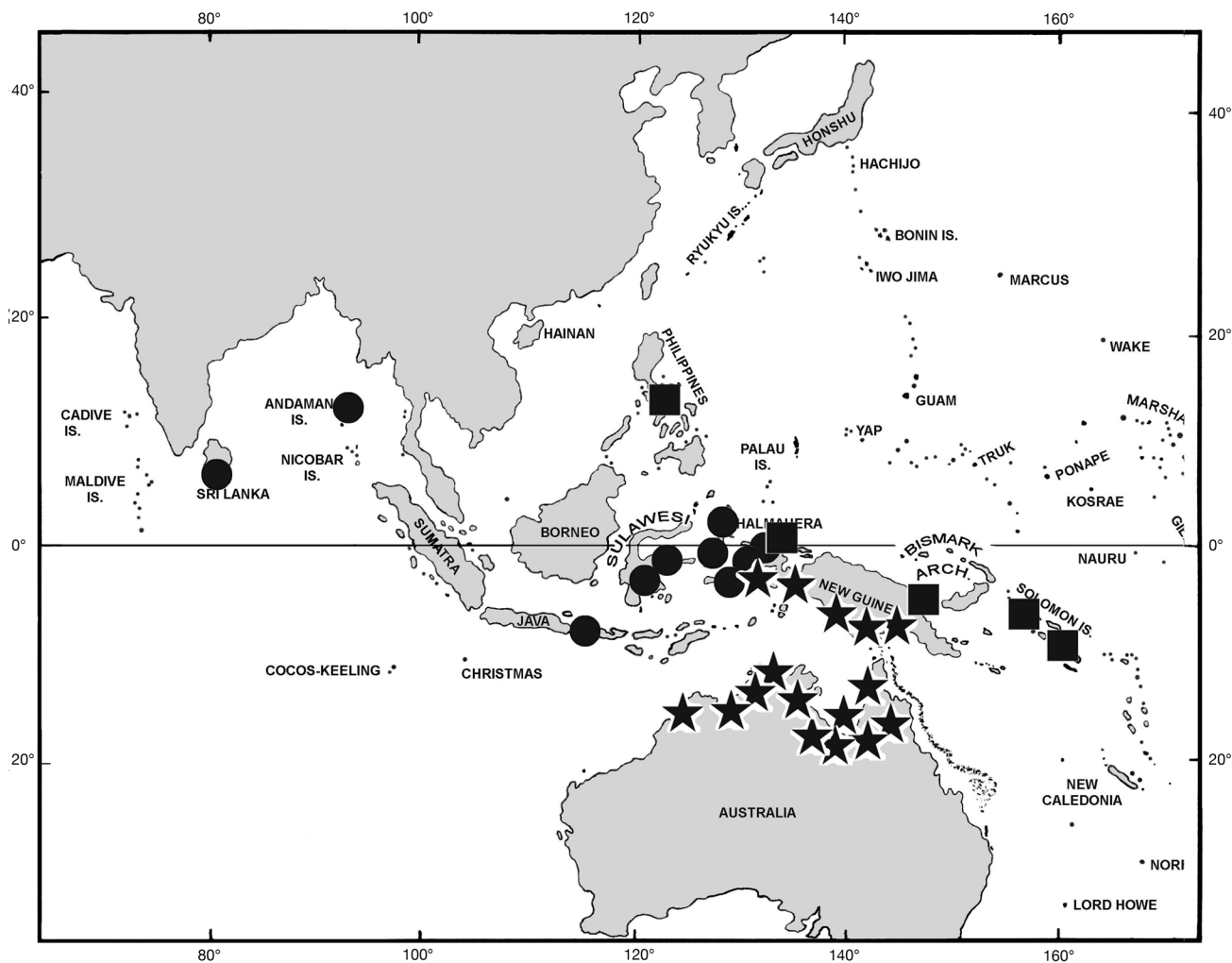


Figure 13. - Distribution of three species of *Glossogobius*, circle = *G. celebius*, square = *G. clitellus*, star = *G. munroi*.

Papillae (Fig. 12)

Line 1 (before nasal pore) composed of single row of papillae. Line 2 (between nasal pores) composed of single row of papillae, line curved, with gap on midline of snout. Line 5 (suborbital) composed of single row of papillae, joining Line 7 below anterior margin of eye; line sometimes a single line, sometimes broken into 2 overlapping lines (often asymmetrical). Line 6 (suborbital branch) formed by disjunction of line 5 in some specimens, but normally absent. Lines 7, 9, 10 (VL cheek rows) each composed of single row of papillae reaching to posterior preopercular margin. Lines 8 and 11 (VT row) reaching just short of end of posterior preopercular margin. Line 12 (Outer POP-mandibular) composed of 2 rows of papillae along lips and a single row posteriorly, with arch at end of lips and no gap. Line 13 (Inner POP-mandibular) composed of single row of papillae. Line 20 (OP VT) composed of 2 rows of papillae, branched ventrally. Line 21 (Upper OT) curved and composed of single row of papillae. Line 22 (Lower OT) composed of single

row of papillae and not branches. Several vertical papillae rows on belly. A single curved line anteriorly on most body scales (often obscure dorsally and posteriorly; dense patch of papillae on chin behind mental fraenum).

Coloration in alcohol

Head and body light brown. Cheeks with scattered small brown flecks. An irregularly shaped blotch before, not forming a distinct stripe to upper jaw; a small dark brown spot behind mid-eye; interorbital region often dark brown; a transverse bar on head between opercula; upper pectoral base with a short brown horizontal bar or sometimes rounded spot; lower pectoral base with small brown spot bar. Back with scattered mottling; an oblique bar from anteroventral part of belly extending dorsoposteriorly forming saddle at base of first dorsal fin, followed by a large spot (equal to eye length) on midside below second dorsal origin in contact with saddle; a similar brown spot on midside below end of second dorsal fin (covering 3-4 scales); a similar midside spot on

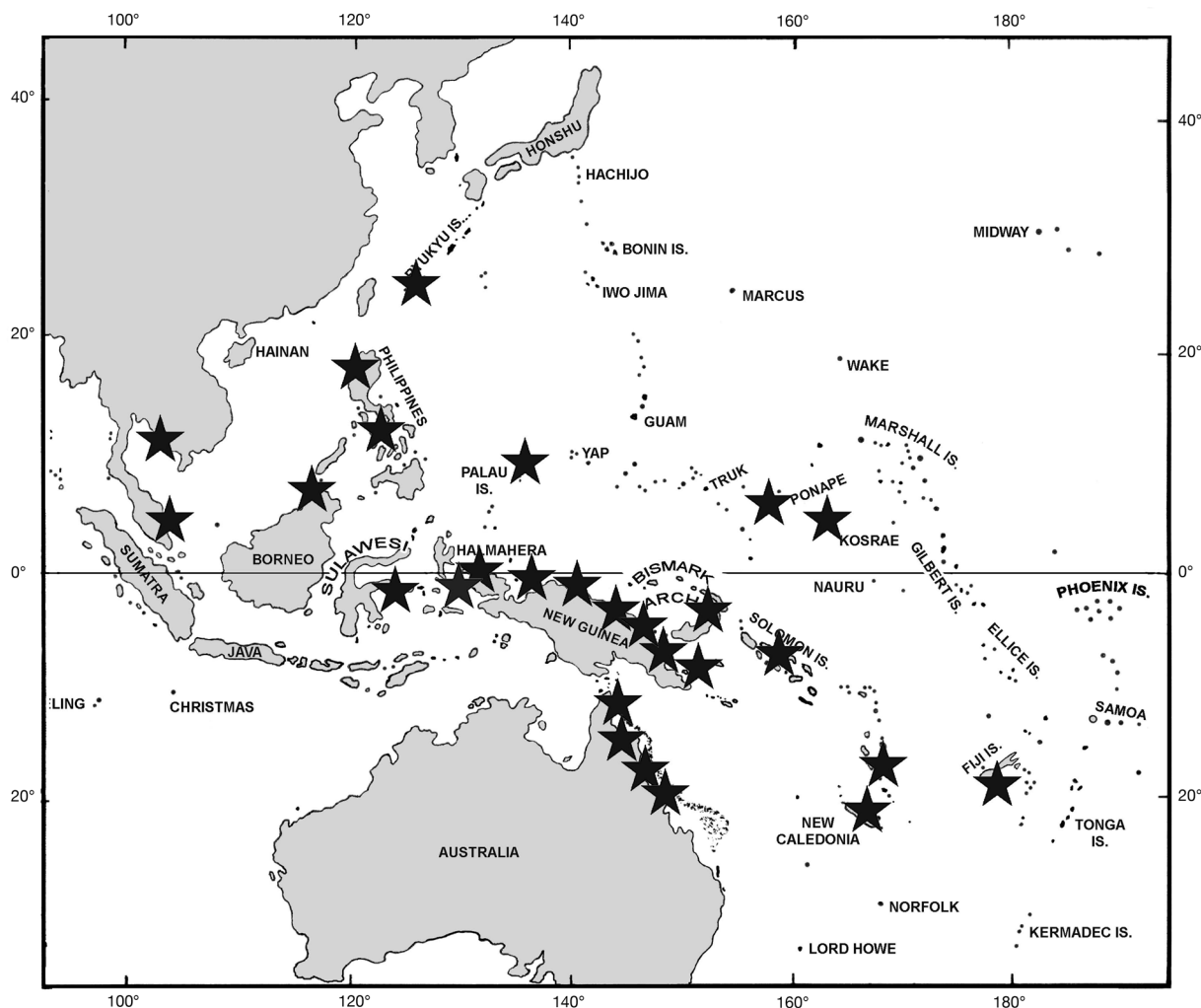


Figure 14. - Distribution of *Glossogobius illimis*.

caudal peduncle; a dark brown triangular spot at posterior end of caudal peduncle (apex pointing forward, length about twice height); dark brown saddle on back between midside spots, with narrow extensions connecting to midside spots. Dorsal fins with spotting forming rows; a small brown spot surrounding middle of sixth dorsal spine or on membrane after fifth dorsal spine, extending to end of fin, prominent in male, obscure in female; caudal fin with small spots forming wavy bars; anal fin white; pectoral and pelvic fins pale to grey.

Some variation in coloration exists. The holotype has dark brown on chin and branchiostegal membranes. In some specimens the saddles on the back are pale.

Distribution

Glossogobius clitellus is known from few specimens from the Solomon Islands, New Guinea and the Philippines (Fig. 13).

Similarity to other species

This species is most similar to *Glossogobius celebius*, *G. illimis* and *G. munroi* in vertebral counts, general head and body shape, mental fraenum shape, and papillae pattern. It differs from *G. celebius* and *G. illimis* in having fewer lateral canal pores, with a shorter lateral canal, the nasal pore in front of posterior nostril (*versus* before or slightly above anterior nostril) and lacking papilla line 6. It differs from those species and *Glossogobius munroi* in having the mouth extending below the middle of eye (*versus* usually below anterior margin of eye to anterior margin of pupil). *Glossogobius clitellus* further differs from *G. munroi* in having fewer predorsal scales (14-17 *versus* 17-28) and in having a more arched back in lateral view. The saddles of *G. clitellus* are distinctive, but *Glossogobius munroi* from New Guinea often have faint saddles and can be confused with *G. clitellus*. The saddles are also sometimes present in *Glossogobius celebius* and *G. illimis*.

Etymology

From the Latin *clitellus* = saddle, referring to the prominent saddles on the back.

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